## Reciprocal Identities

$\csc x = 1/\sin x$
$\sec x = 1/\cos x$
$\cot x = 1/\tan x$

## Half-angle identities

$\sin (x/2) = \text{radical}((1 - \cos x)/2)$
$\cos (x/2) = \text{radical}((1 + \cos x)/2)$
$\tan (x/2) = (\sin x / 1 + \cos x)$

## Transformations

**Translations**

$g(x) = f(x) + k$ is the graph of $f(x)$ translated $k$ units up when $k > 0$ and $k$ units down when $k < 0$.

$g(x) = f(x - h)$ is the graph of $f(x)$ translated $h$ units right when $h > 0$ and $h$ units left when $h < 0$.

**Reflections**

$g(x) = -f(x)$ is the graph of $f(x)$ reflected in the x-axis.

$g(x) = f(-x)$ is the graph of $f(x)$ reflected in the y-axis.

**Dilations**

$g(x) = a \cdot f(x)$ is the graph of $f(x)$ expanded vertically if $a > 1$ and compressed vertically if $0 < a < 1$.

$g(x) = f(ax)$ is the graph of $f(x)$ compressed horizontally if $a > 1$ and expanded horizontally if $0 < a < 1$.

## Domain and range

**Domain**: The domain of a function is the set of all possible input values (often the "x" variable), which produce a valid output from a particular function. It is the set of all real numbers for which a function is mathematically defined.
**Range**: The range is the set of all possible output values (usually the variable y, or sometimes expressed as f(x)), which result from using a particular function.

## Cotangent/Tangent

$\tan x = \sin x / \cos x$
$\cot x = \cos x / \sin x$

## Double-angle identities

$\cos 2x = \cos^2 x - \sin^2 x$
$\sin 2x = (2\sin x)(\cos x)$
$\tan 2x = (2\tan x / 1 - \tan^2 x)$

## Parent functions

constant function
$f(x) = a$ graph is a horizontal line
identity function
$f(x) = x$ points on graph have coordinates (a, a)
quadratic function
$f(x) = x^2$ graph is U-shaped
cubic function
$f(x) = x^3$ graph is symmetric about the origin
square root function
$f(x) = \sqrt{x}$ graph is in first quadrant
reciprocal function
$f(x) = 1/x$ graph has two branches
absolute value function
$f(x) = |x|$ graph is V-shaped

## Pythagorean Identities

$\sin^2 x + \cos^2 x = 1$
$\tan^2 x + 1 = \sec^2 x$
$1 + \cot^2 x = \csc^2 x$

You can convert the first identity into the second and third by dividing both sides by $\cos^2 x$ or $\sin^2 x$.

## Exponential and logarithmic

Logarithmic
$y = \ln x$
Exponential
$y = b^x$

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